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Jeffrey A. Chartrand

Archaeological Resource Visibility and GIS: A case study in Yorkshire

1 Introduction

This paper is an attempt to highlight some methodological issues for the examination of archaeological site visibility. It is based upon the concept of predictive visibility templates within the domain of Geographical Information Systems (GIS). The research presented here is an exploration of the potential for the application of recently appropriated methodological tools, specifically GIS, to extant archaeological data for the identification of visibility templates (Carver 1990) incorporating a synthesis of selected environmental and cultural factors.

2 GIS Past and Present

GIS are an example of a research toolkit and methodology which developed outside archaeological method and theory but which are seen by many to have potential in archaeological investigations. In archaeology, GIS are a fairly recent phenomena reflecting the diffusion of a technique from spatial geography to archaeological spatial issues. As with many techniques which are adopted rather than developed, GIS have suffered from dislocation. Our zeal for the GIS toolkit has resulted in the vast majority of archaeological GIS projects being driven by the tool rather than being part of a developing archaeological spatial information management system. The era of GIS being another tool simply to put crosses on maps is at last coming to an end. In recent GIS projects one can see the re-emergence of the research goals from the abyss of hardware potential (cf. Thoms 1988). The need for the development of archaeological spatial methodology to guide and direct the use of GIS in archaeological investigations allows us to re-examine key issues in archaeological spatial analysis.

3 Data Representivity

One of the primary conceptual concerns for archaeological resource visibility is the issue of the representivity of the data. In the past the development of archaeological predictive models depended primarily on broad regional projects which generally built upon existing research supplemented with extensive field truthing (cf. Hasenstab/Resnick 1990; Kvamme 1988). Data collection in these projects provided primary data rather than depending upon secondary or even tertiary data. Because of the wealth of the archaeological record in the UK, regional analysis has not generally employed extensive field testing. Consequently we must choose to either ignore the extant record or incorporate these records into our research agendas and models. Data from the archaeological record is an incomplete, biased, non-random collection of information from which we are supposed to hypothesize about past activities and events. Although sounding bleak the situation is not as bad as it sounds. To use this biased data we are going to have to learn to apply *source criticism* to the archaeological record so that material collected by a great number of people over a long period of time can be incorporated into current research. As a result of the failure of many researchers to actively apply data validation, and the past emphasis on an environmentally deterministic approach, few models have progressed from their initial conception into general acceptance within the archaeological community.

It has therefore become apparent that the application of new spatial tools to archaeological data requires an examination of the limitations of the methodology of the spatial toolkit as well as the application of source criticism to data sources before meaningful attempts to create predictive visibility templates can be made.

To this end this paper will present a few of the approaches which may be directed to the resolution of a number of questions relating to the creation of visibility templates.

4 Data Mismatch

The work presented in this paper is one of a group of projects initiated by the Department of Archaeology, University of York, to look at the Roman, Anglian, Anglo-Scandinavian and Medieval town of York and its relationship with its hinterland. This paper deals specifically with the issue of Archaeological Resource Visibility with reference to the Iron Age/Roman interface. This period was chosen for a number of reasons, though the main one is that the arrival of the Romans is well established and represents a readably identifiable foreign material culture. As such it was felt that this cultural upheaval would be

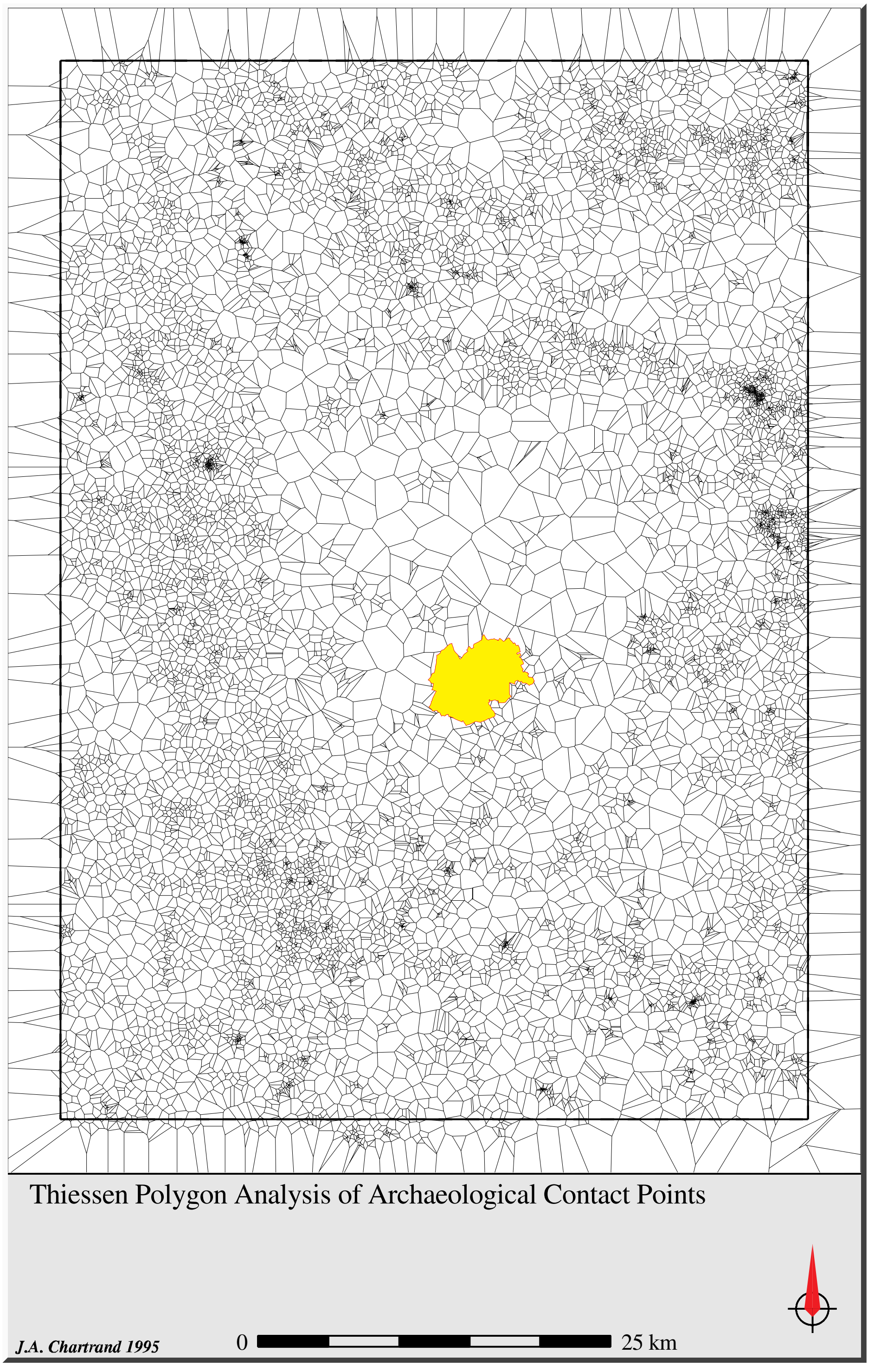

Figure 1. Multi Period Thiessen Polygons for Archaeological Contact Points.

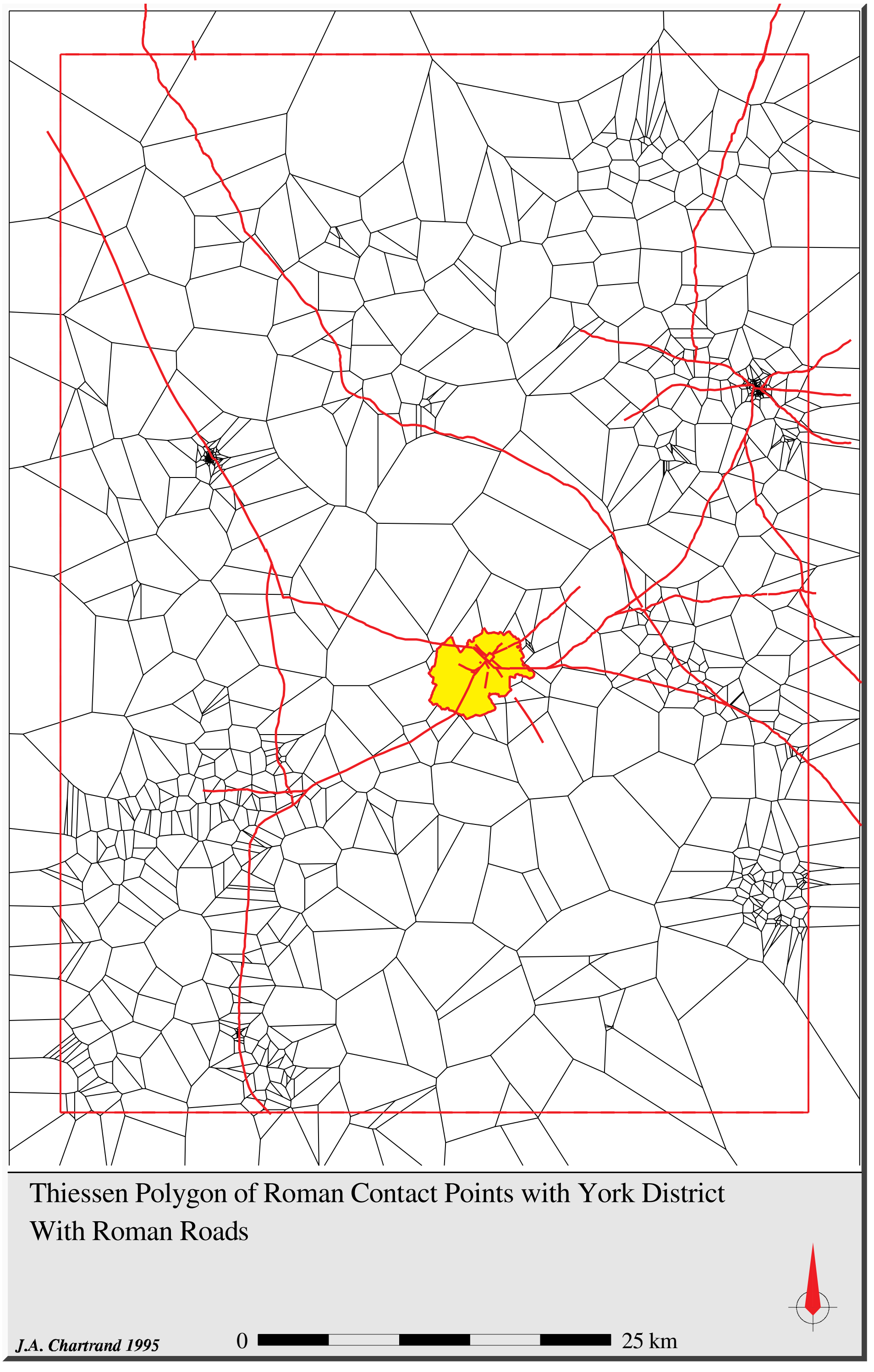

Figure 2. Roman Period Thiessen Polygons with Roman Roads.

visible in the archaeological record from material culture and land exploitation patterns. Considering this distinct cultural horizon we can identify both environmental and cultural variables which may bias the recovery of archaeological material. Archaeological Resource Visibility (ARV) factors include:

Environmental Factors
- Physical
  - Soil Type
  - Geology
  - Geomorphology (landforms)
  - Aspect
  - Slope
- Vegetation
  - Natural plant coverage
  - Exploitive vegetation

Cultural Factors
- Physical
  - Land Use
  - Proximity to modern foci
  - Proximity to historic resources
- Social
  - Historic selection preferences
  - Recognition
  - Field techniques

The first step in the application of source criticism to archaeological data is to look at the basic nature of the archaeological record and identify the strengths and weaknesses of the potential archaeological resource.

Archaeological data has three key properties associated with resource visibility. The first of these properties is spatial location. It is this feature which makes reliable spatial tools essential to the future of archaeological analysis and interpretation.

The second essential property of archaeological data is placement in the temporal continuum, what we generally think of as the date. It is important to make the distinction between date and ethnicity. For example, material identified as part of 'Roman culture' is present within the study area as a result of trade prior to the Roman conquest. Conversely, archaeological evidence identified as 'Iron Age culture' will continue to be produced long after the Romans have arrived. Two distinct archaeological cultures may thus occur in a single temporal and spatial location.

The third property of archaeological data is our subjective classification of it. What have we identified and how? Our ability to interrogate data depends greatly upon the form and structure of the archive. Traditional recording has focused upon functional analysis, determined archaeologically, stored in text based format. Although this is changing with the inclusion of graphics and the use of alternative classification systems the effects of traditional data structure are still an important issue in data archive and retrieval. Documentation of the decisions of what information is stored and the form in which it is stored is important information for any subsequent use.

5 Geographic Information Systems

In essence the GIS function is to provide a method of filtering the large dataset and providing the basic spatial analysis tools with graphical output.

The digital data set which is being used comprises records from three very different county systems in very different formats. The study area encompasses three regional administrative bodies responsible for the recording and archiving of archaeological data. The bulk of the data is held by the North Yorkshire County Council in three independent mainframe (ICL) databases:

NYSMR (full citation record) 9426 records
NYSIN (selected citation record) 3719 records
NYAP (separate listing of aerial photography) 10906 records

The remaining data is held by Humberside County Council and West Yorkshire Archaeological Service on PC based systems:

Humberside (dBASE III+) 3333 records
West Yorkshire (Superfile) 1738 records

The primary difficulties encountered, once exportable data was extracted from the various systems, can be defined into two broad groups:

1. data structure differences:
   - different fields
   - different field types
   - different data formats
2. terminology differences:
   - lack of standard terms
   - differences in period starts and finishes
   - temporal period versus ethnic group

Another issue addressed by this project is the urban versus rural archaeological data mismatch, in terms of both data structure and data quantity. Landscape archaeologists have spent considerable time discussing how a 'site' should be defined, and have resolved that it simply represents an area of the landscape where there is a relative increase in the density of activity (Gaffney/Tingle 1985). In the case of a town, the complete urban core can be regarded as an arbitrarily defined site which has a number of components. The issue of viewing the archaeological resource in terms

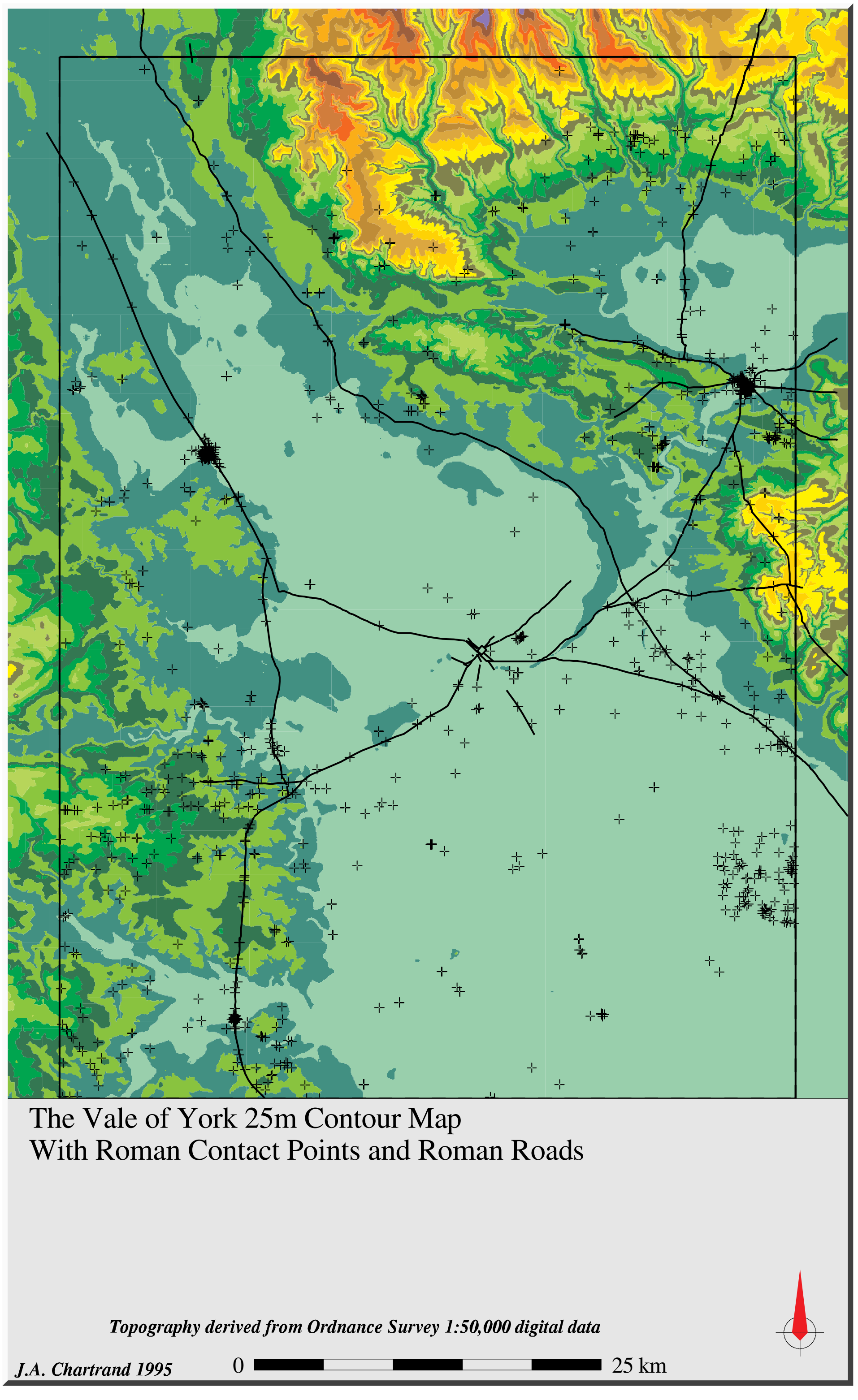

Figure 3. 25 m Shaded Contour Vale of York with Roman Contacts and Roman Roads.

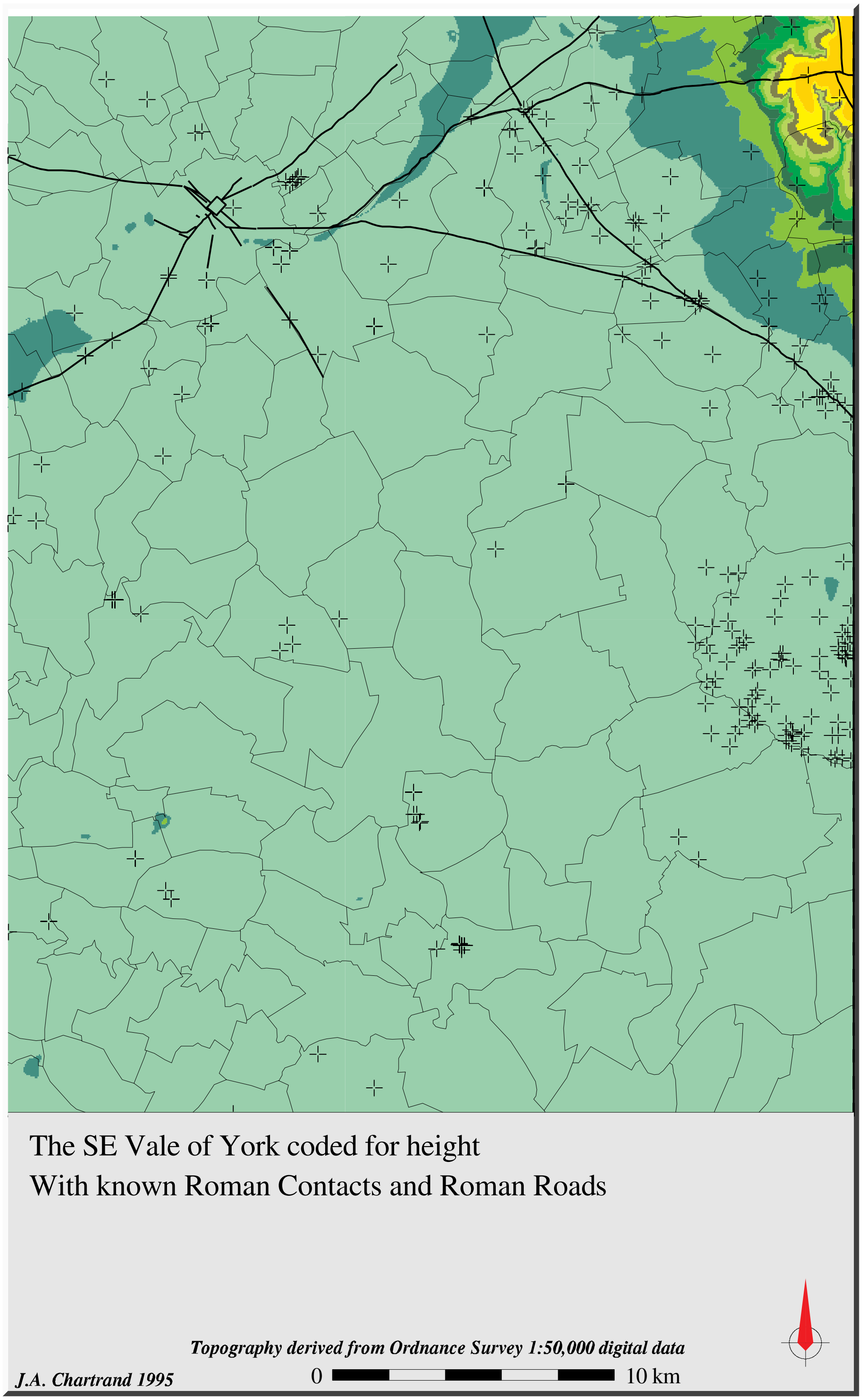

Figure 4. 25 m Shaded Contour SE Vale of York with Roman Contacts and Roman Roads.

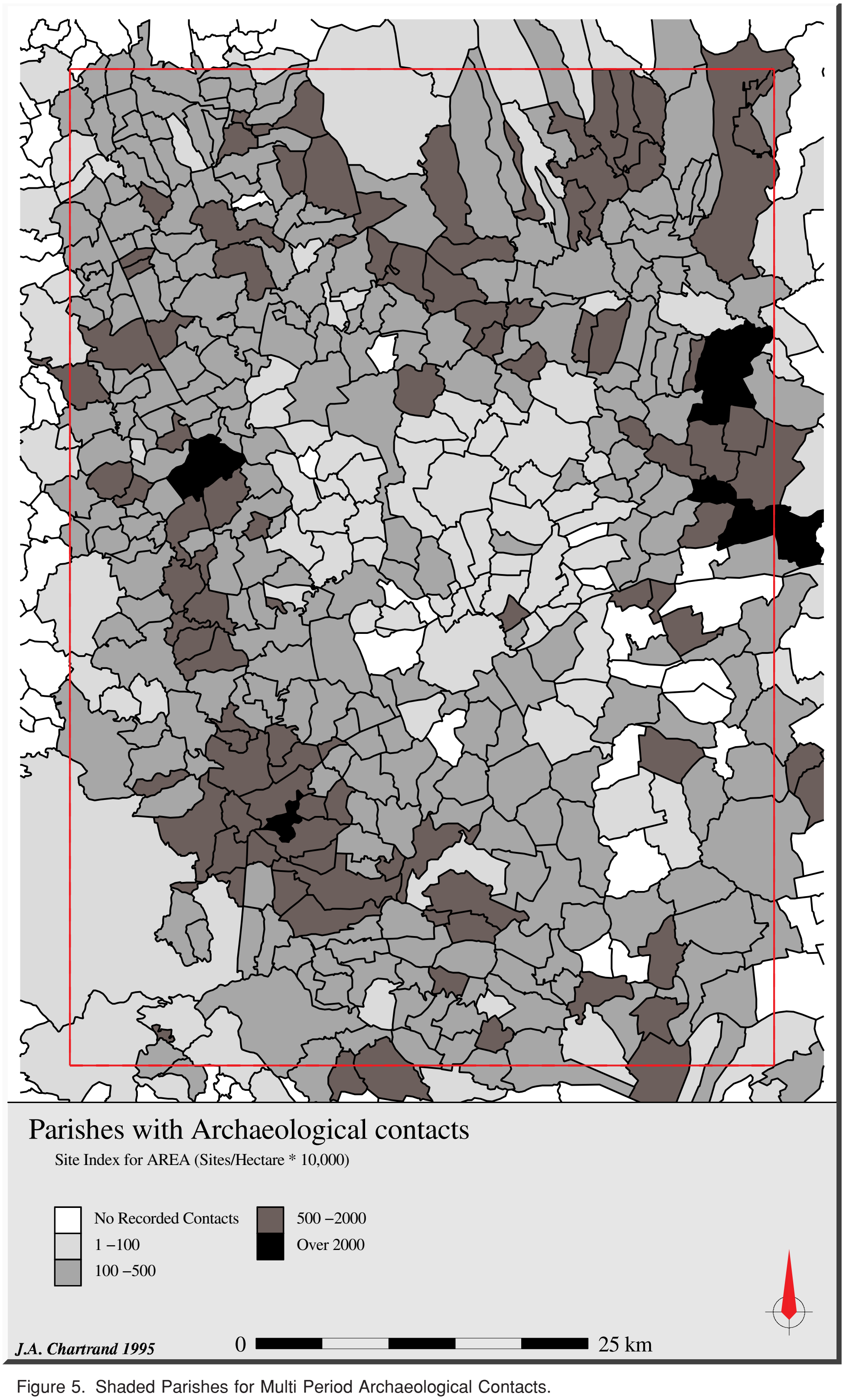

Figure 5. Shaded Parishes for Multi Period Archaeological Contacts.

of components is essential for this project. The component approach allows for the aggregation of data into spatial or temporal themes. Given the density of urban activity, and the vertical build-up of considerable thicknesses of deposits in urban areas, it is also more likely for the same horizontal spatial coordinates to be the location of a number of activities, separated in time. In fact this is just an extension of the problems which face those who try to provide a relational structure for a Sites and Monuments Record where sites often have remains representing several periods.

An essential point to remember in any archaeological study which includes well defined urban areas and substantial hinterlands is that both the town and country are part of the same landscape. It is the division in the way that archaeological data is collected and stored which generates a false distinction. In fact, it is rarely possible to draw a neat box around a town to define the point at which urban influences stop. In practice, there may be a number of boundaries, according to the aspect of urban life that is under consideration: craft activity, settlement, religious control, political control, landownership, artefact fall-off etc.

A discussion of the database approach and data structure utilized in this project has been previously presented by the author, including a fuller discussion of data fields, terminology and coding issues (Chartrand/Miller 1994).

6 The Results

The first step was to apply source criticism to the archaeological resource. In looking for tools to examine the issue of potential contact points[1] I have resurrected a tool from the past, Thiessen Polygons. Archaeological information as stored in the different databases varies widely within and between datasets. Some of the NYSMR includes full spatial records for each artifact where as others only have a single record for an entire excavation. Similarly, discrete temporal uses at a shared geographical location occur in many cases. To provide an indication of known archaeological contact we needed a system which would display contacts but which would not bias site location as a result of recording bias. Figure 1 is an example of the creation of Thiessen polygons based upon all known archaeological contacts. The smaller the polygon the more contacts in that area. This is a useful way of showing the overall distribution of the known archaeological contacts. The Vale of York north of the city of York has a low level of known contacts. This is also visible in the Vale of Pickering. The project border area also indicates something about the completeness of our data. Notice that for all of the boundary edges the polygons become large and elongated. This illustrates where the analysis is suffering from edge effects and demonstrates the need for project datasets to extend beyond the analytical boundary. The technique shows some interesting patterning and it provides some starting points for further investigation.

The same procedure can be applied to thematic questions. Figure 2 is a Thiessen polygon analysis based upon known Roman contacts. Even without any other data we begin to see some interesting patterns in the data. We can identify some known settlements and we can see some areas where there is very little known Roman material. As demonstrated in these two examples (figs 1, 2) the Thiessen polygon technique can be used to look at the spatial potential of the archaeological record.

Given that the distribution of archaeological material has been shown to be non-uniform we now need to examine specific ARV factors. One approach to the identification of landform significance is the use of the Ordinance Survey digital height data coded by 25 m groupings (fig. 3) using a standard topographical colour ranking. To this have been added Roman Roads and known Roman contact points. Notice that for the most part finds are associated with Roman Roads and known Roman settlement sites: i.e. York, Aldbrough, Malton, Castleford. Examination of the known Roman roads shows the truncation of the westward branch shortly after leaving the Vale. Roman contact points beyond this truncation strongly support the continuation of the road further into the upland area and may represent the major east-west travel route for the study area. One anomaly not associated with either the road or known settlement sites is the cluster of Roman contacts to the southeast edge of the project area. Upon further examination this proved to be the result of an intensive field programme by Durham University (Millett 1995). This anomaly (fig. 4) illustrates very clearly that the absence of known Roman contacts in the record in adjacent parishes is probably not related to potential resources but relates to the level of intensive field research illustrating the need for a detailed knowledge of historical archaeological projects.

The primary spatial recording unit for all three administrative bodies is the civil parish. The effect of the Durham survey on the point data has been shown in the previous figure. Identification of parish trends is an indicator of positive and negative bias in recording. Given the irregular size and shape of the parishes a system of indices has been employed. Figure 5 uses an index of site presence based upon sites per hectare for all archaeological contacts for each parish in the survey area. The results show a correlation between the geomorphology zones which border the Vale of York and point to a generally lower presence of material north of the city of York. The specific reasons for this are not clear at this time. This pattern may be a function of visibility due to environmental factors or related to modern activity.

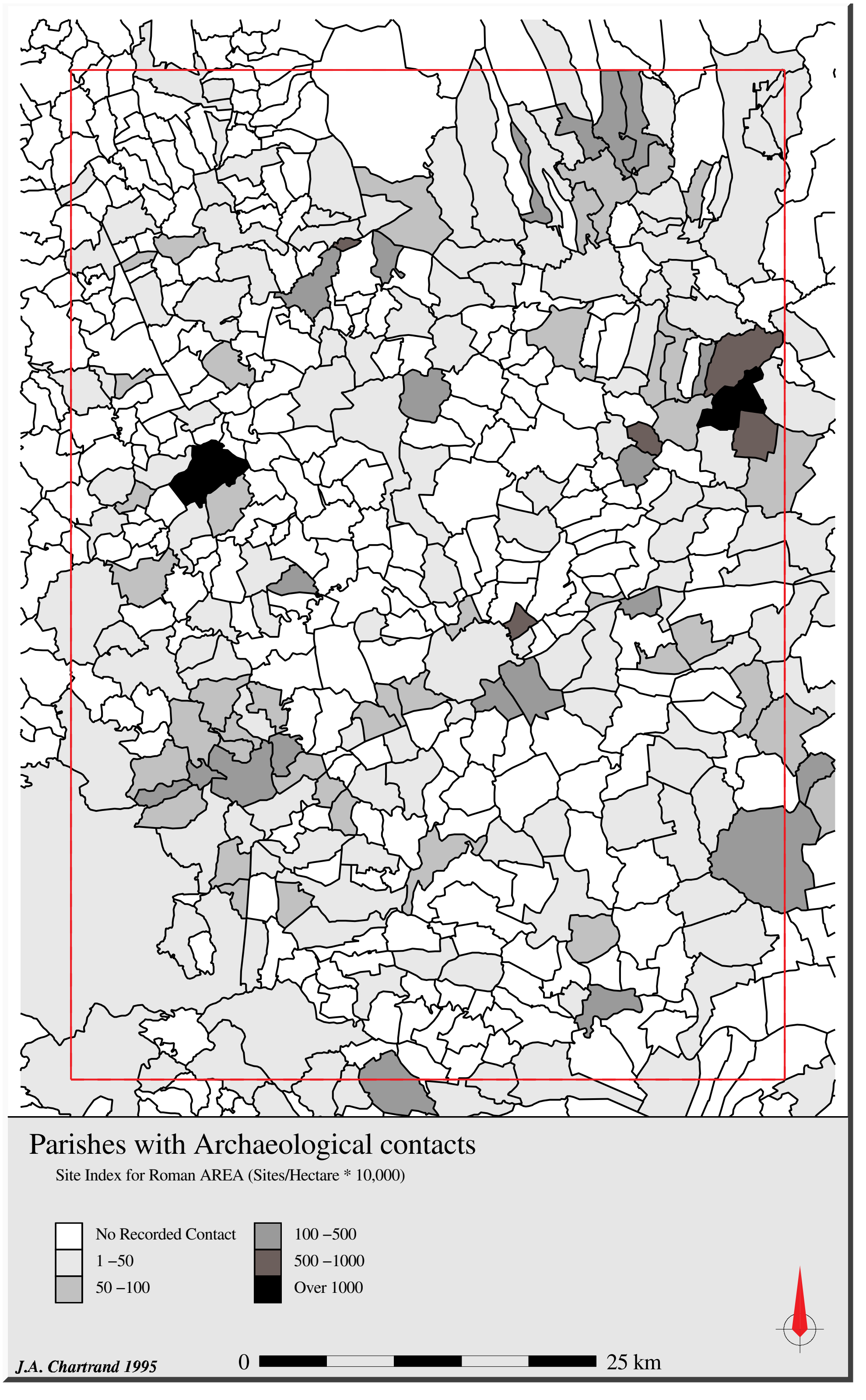

Figure 6. Shaded Parishes for Roman Period Archaeological Contacts.

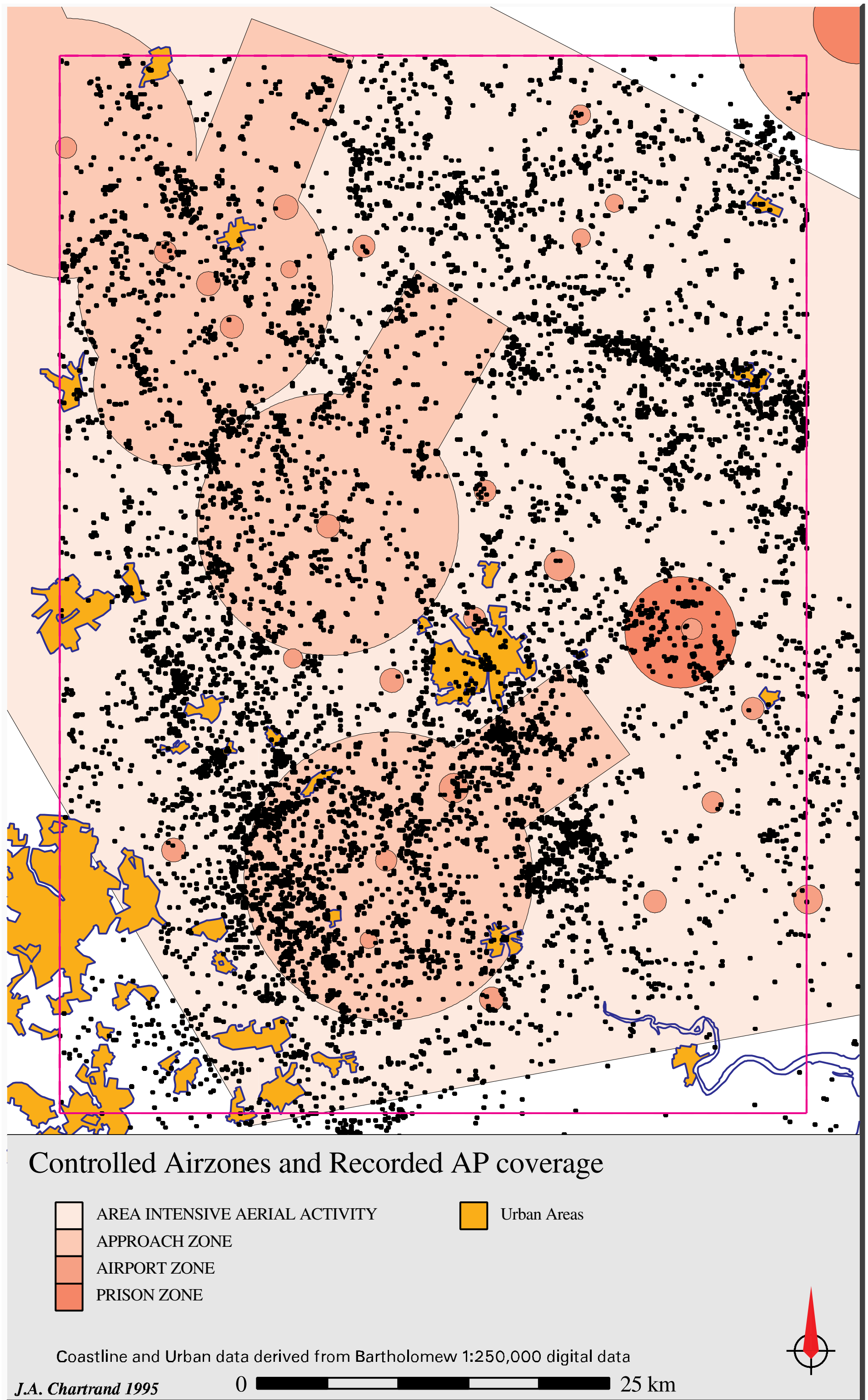

Figure 7. Controlled Airzones and Recorded Archaeological Aerial Photographs.

Using the same criteria the Roman Index (fig. 6) produces a pattern which is all too apparently related to recovery factors rather than being a product of Roman activity. Far too many parishes remain blank if we consider the Durham study as a guide to the Roman archaeological resource potential for the area. The distinction between parishes in the area, and specifically with the Durham Parish study, is a function of collection bias rather than Roman utilization.

The effect of modern land use and field recovery techniques is not limited to terrestrial approaches. The coverage of Aerial photography for the region has been plotted on a background map of the aerial control zones which affect flight patterns. It had been expected that the flight control areas associated with airports would have negatively affected coverage. In fact if we examine the result in figure 7 that does not appear to be the case. Several linear patterns can be seen to correspond to high occurrences seen on the Indices maps. The theory has been put forth that these may reflect the use of modern linear features, such as major road routes, for pilot navigation in addition to environmental factors of geomorphology and soils.

7 The future: Where to next?

The results presented in this paper are a reflection of work in progress but they show the potential for the use of the Archaeological Record. This project has demonstrated the use of the extensive machine readable data stored in the SMRs. For the work to progress we need to consider several issues. The volume of data in these datasets precludes being able to validate each piece of data, therefore we need to incorporate validation information into each record. The first step is to examine the records and see what the representation of the archaeology is at present and to try and find some explanations for its condition. The biggest obstacle that we face is convincing funding bodies and fellow archaeologists about the desirability of data enhancement, one of the most poorly resourced and least appreciated jobs in archaeology. Until we have a better understanding of the potentials and pitfalls of the archaeological record it will be impossible to progress from the environmentally deterministic modelling which can be seen to be so limiting. To this end I see the importance of including more information on the process of data collection and recording. Data validation information needs to be incorporated in the archaeological record for spatial, temporal and interpretational factors. For example, the incorporation of a precision field should be stored with every spatial location in order to indicate the accuracy of recorded spatial locations. Conversion of a 6 figure OS grid reference to a 12 figure location for GIS work will result in a 1000 m variation for actual location. We also need to record information on dating methodology. How are archaeological contacts dated — contextually, stratigrapically, by inference, scientifically or through a combination of techniques? This needs to incorporate a subjective evaluation of reliability. Researchers need to know, for example, if a contact: a) might be Roman, b) probably is Roman or c) definitely is Roman.

We need this information to examine the resource potential of both known and unknown landscapes for an evaluation of the 'archaeological value' — the matching of a deposit model or template with a research agenda.

It is essential that we change our approach to GIS so that we develop it into a tool that is part of our spatial methodology rather than our spatial methodology being the GIS. A tremendous amount of time and resources have been put into archaeological GIS but if it is to be anything more than a white elephant we must prevent the tool from dominating the craftsman. This project has shown that the vast amount of digital archaeological data collected for Archaeological Resource Management (ARM) can be used to examine archaeological research issues. It is now time to start putting our digital house in order so that new research tools can benefit archaeological research and management.

Acknowledgements

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note

1 Archaeological contact points are unique spatial locations where a recorded contact of an archaeological nature exist in fact or in record.

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